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# A Primer on PFAS

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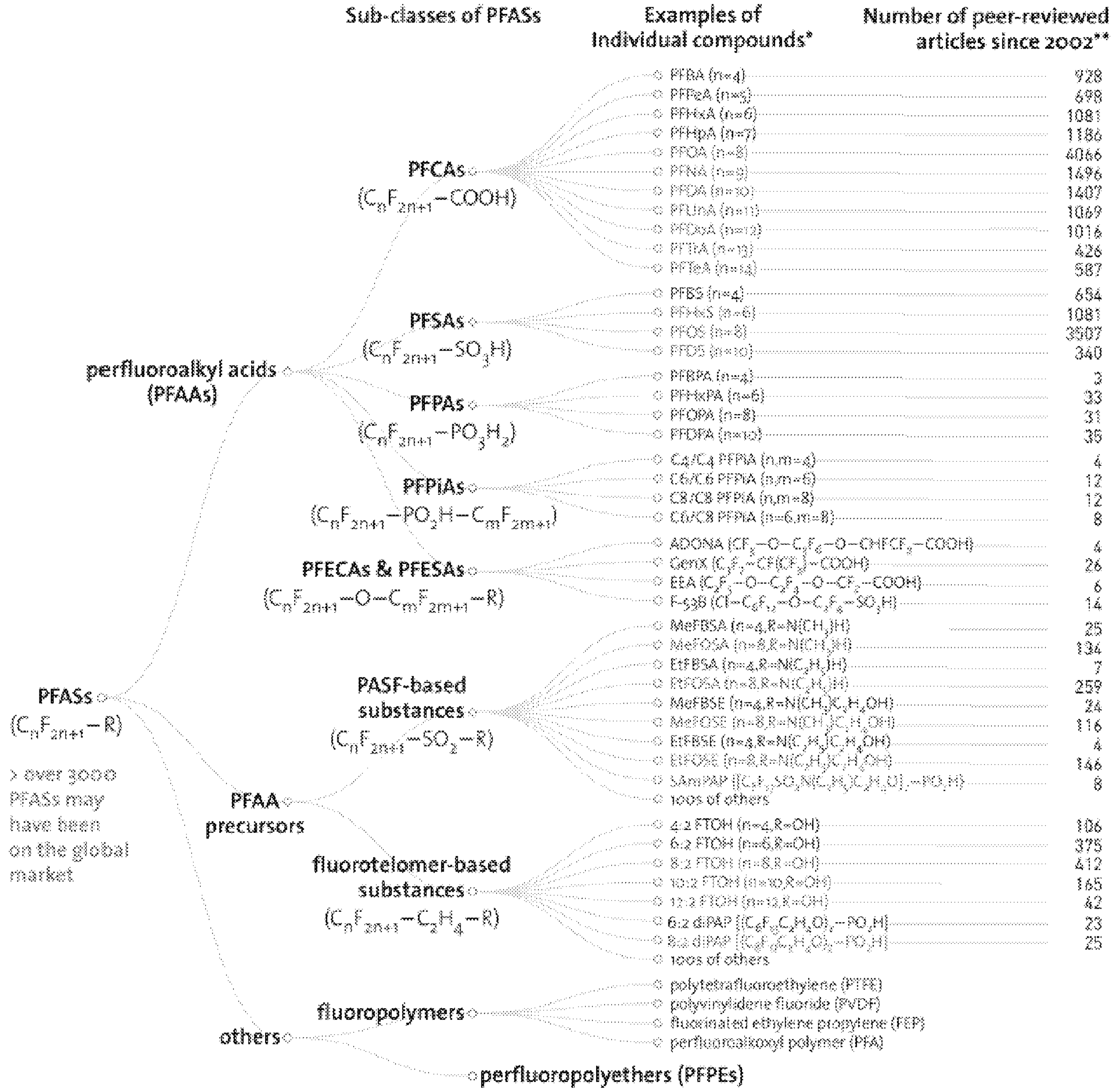
Polyfluorinated and perfluorinated substances, more commonly known as PFASs, are gaining attention in the media as a health and environmental risk to millions of Americans.[1] PFASs are found in myriad useful products, from clothing to food packaging to building materials, and they have been found in drinking water supplies across the country at levels exceeding an EPA health advisory. Investigating and regulating PFASs have become priorities for federal and state policy makers. PFASs in the environment, including in water supplies, have triggered numerous lawsuits. This paper provides a primer on PFASs history and chemistry, the response by various stakeholders, including EPA, states, water suppliers, and the courts to PFAS contamination, and the likely impacts PFASs will have on site remediation and environmental litigation for years to come.

## I. Background

PFASs are a generic term for a family of per- and polyfluoroalkyl substances, which include perfluoroalkyl acids (PFAAs). PFASs are synthetic chemicals that have many valuable properties, including fire resistance and oil, stain, grease, and water repellency.[2] PFASs were first developed in the 1930s, and within 30 years could be found in firefighting foams, wire insulation, cleaners, textiles, apparel, carpet, leather, paper, and paints.[3] The first PFASs developed were "long-chain" PFAS, which means they have eight or more carbon atoms.[4] These include the two most widely known PFASs, perfluorooctanoic acid (PFOA) and perfluorooctane sulfate (PFOS). Beginning in the 2000s, companies began to develop "short-chain" PFAS, meaning they have fewer carbon atoms.[5] GenX is one of the most well-known short-chain PFASs. So far, scientists have discovered 500 types of previously unrecorded PFAS in the past decade and have listed more than 4,500 chemical structures.[6] See Figure 1, below. Because of their widespread use and persistence (i.e., PFAAs do not appear to degrade naturally), PFASs are now found worldwide in the environment, wildlife, and humans.[7] According to industry human biomonitoring data, PFOA is also found in the blood of the general population in all geographic regions of the United States.[8]

***Figure 1. "Family tree" of PFAS chemicals*[9]**




* PFASs in RED are those that have been restricted under national/regional/global regulatory or voluntary frameworks, with or without specific exemptions (for details, see OECD (2015), Risk reduction approaches for PFASs. http://oe.cd/1AN).
** The numbers of articles (related to all aspects of research) were retrieved from SciFinder® on Nov. 1, 2016.

Figure 1. "Family tree" of PFASs, including examples of individual PFASs and the number of peer-reviewed articles on them since 2002 (most of the studies focused on long-chain PFCAs, PFSAs and their major precursors.).

## A. Environmental and Health Risks Remain Under Study

The widespread presence of PFASs, particularly in light of the extreme persistence of PFAAs, has the potential to be harmful to the environment and human health. With exposure, PFASs accumulate in the blood and liver. Because PFAAs are not metabolized, they can bioaccumulate in terrestrial food webs and in marine mammals, meaning that organisms higher in the food chain generally have higher PFAS levels than those lower in the food chain.[10]

In addition to environmental impacts, studies have shown that PFASs, specifically PFOA and PFOS, are associated with adverse health effects. Peer-reviewed studies on laboratory animals and epidemiological studies of human populations indicate that exposure to PFOA and PFOS over certain levels may result in developmental effects to fetuses and infants, cancer, and impacts to the liver, thyroid, immune system, and cholesterol changes.[11] However, despite two decades of studies, "toxicologists are still struggling to work out exactly how PFASs cause problems in the body."[12] This is only complicated by the continuous identification of new PFAS structures, each of which may cause different harms or work in a different way.[13]

### B. PFAS Contamination Sources

To date, the two most well-characterized sources of PFAS contamination are manufacturing plants and releases of aqueous film-forming foam (AFFF) used for fuel fires.

Many manufacturing facilities used PFASs starting in the 1950s. For example, in Parkersburg, West Virginia, DuPont used PFOA to make Teflon for over 40 years, resulting in PFOA powder releases into the Ohio River and sludge-containing PFOA into digestion ponds near the facility. PFOA entered the local water table, contaminating drinking water for more than 100,000 people.[14] Similarly, in Hoosick Falls, New York, a manufacturing plant used PFOA to make stain resistant fabric. In a personal injury suit, the plaintiff alleges that employees discharged PFOA by dumping trays of cleaning residue containing PFOA into drains, which contaminated soil, groundwater, and ultimately the town's public water supply.[15] Similar drinking water contamination originating from manufacturing plants has been discovered across the country, including in Minnesota, Alabama, Vermont, New Hampshire, and New Jersey.

Drinking water on and around military installations and civilian airports has been contaminated with PFAS due to the use of AFFF to fight fires. Although Department of Defense ("DOD") memoranda indicate that DOD knew about the possible risks of PFASs in AFFF since the early 1980s, DOD has only recently begun to investigate PFAS contamination on and near its facilities.[16] In the past several years, DOD has identified over 400 active or closed installation with known or suspected releases of PFOS or PFOA.[17] As of December 2016, DOD had spent at least $200 million for investigation, remediation, and alternate water supply provision and is projected to spend millions more to treat water and provide alternate drinking water sources.[18] For example, a June 2017 Air Force Interim Feasibility Study of Eielson Air Force Base in Alaska developed seven cleanup options to address drinking water wells contaminated with PFAS ranging in cost from $32 million to $67 million.

### C. PFAS Due Diligence

Phase 1 site investigations may miss the potential for PFAS contamination, as these chemicals were not historically considered hazardous.[19] Thoroughly understanding the historical uses of a site, along with the historical uses of PFAS, is critical to identifying potential PFAS contamination at a site.[20] Once soil and groundwater sampling at a site begins, it may remain difficult to identify the source of PFASs at a site, given the thousands of types of PFAS and their different changes over time and fate and transport mechanisms.[21] In addition, many PFAS releases occurred decades ago, giving PFAS plumes time to develop.[22] Further, many materials typically used for environmental sampling contain PFASs, and because many PFASs may be concerning even when present in several parts per trillion (ppt), accurately sampling a site may be difficult.[23] Regardless of these challenges, PFASs will certainly be included in due diligence for property transactions going forward, given the growing concern surrounding these chemicals.

### D. Developing Remediation Technologies

Thus far, PFAS remediation projects have typically used carbon filters that can catch long-chained PFASs; however, the filters are much less effective for the short-chained substitutes.[24] Even after PFASs have been removed from water or soil, PFAS-laden filters must be disposed of. Currently, much of this waste ends up in landfills, but that may just be creating another problem, as PFASs from treatment filters can seep into the ground, particularly in unlined landfills.[25] Further research is needed to develop cost-effective destructive technologies for PFASs that result in complete mineralization, e.g., removing the fluorine atoms from the carbon atoms.[26]

## II. Federal Action

**Early 2000s – Self-Imposed PFOS Manufacturing Ban.** In the late 1990s, EPA received information indicating that PFOS in particular was widespread in the blood of the general population and presented concerns for persistence, bioaccumulation, and toxicity.[27] Following discussions between EPA and 3M—the sole manufacturer of PFOS in the United States and the principal manufacturer in the world—the company terminated production of these chemicals.[28] In 2002 and 2007, EPA took action to limit future manufacture and importation of PFASs, particularly perfluoroalkane sulfonates (PFSAs).[29]

**2006 – EPA Initiates PFOA Stewardship Program.** In 2006, EPA invited eight companies in the PFAS industry to join a global stewardship program with the goals achieving a 95% reduction in PFOA and related emissions by 2010 and eliminating PFOA and related chemicals from emissions and products by 2015.[30] This program helped successfully phase out the manufacture and import of PFOA into the United States, although existing stocks of PFOA may still be used, and PFOA may still exist in imported goods.[31]

**2013-2015 – Drinking Water Testing.** The Safe Drinking Water Act (SDWA) requires that once every five years, EPA issues a new list of no more than 30 unregulated contaminants to be monitored by public water systems. Pursuant to the SDWA, in 2012, EPA published the Third Unregulated Contaminant Monitoring Rule (UCMR 3), which included PFOS and PFOA, as well as several other PFAS chemicals. UCMR 3 monitoring found that over 100 public water systems contained PFOA, and many others contained some type of PFAS.[32]

**May 2016 – EPA Issues PFOS and PFOA Health Advisories.** In May 2016, EPA established drinking water health advisories for PFOA[33] and PFOS,[34] setting the advisory level at 70 ppt. These advisories provide technical information to state agencies and other public health officials on health effects, analytical methodologies, and treatment technologies associated with drinking water contamination; however, complying with these drinking water health advisories is not mandatory. Despite their non-binding nature, these advisories have set the first national reference points against which the public and water suppliers can evaluate potential health risks associated with PFAS-family substances.

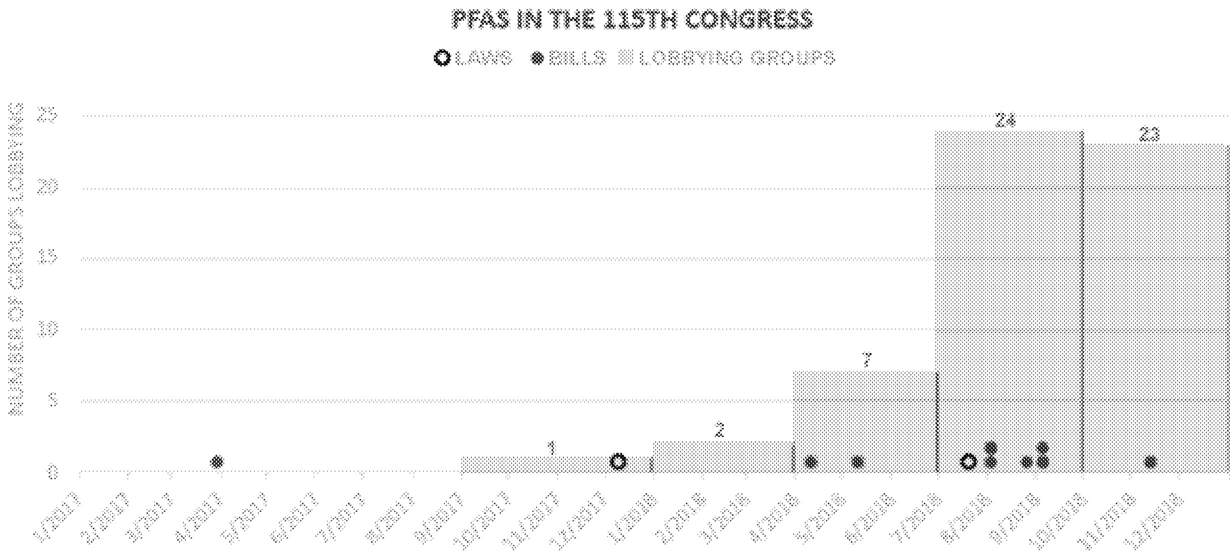
**May/June 2018 – ASTDR Study and EPA Planned Actions.** In May 2018, EPA was criticized for blocking publication of an Agency for Toxic Substances and Disease Registry (ATSDR) study that reportedly would have shown that PFASs endanger human health at a far lower level than the EPA health advisory limits.[35] Faced with this criticism, former EPA Administrator Scott Pruitt announced in May 2018 several planned actions on PFASs, including:

- Establishing a binding maximum contaminant level (MCL) for PFOS and PFOA "in earnest;"
- Classifying PFOA and PFOS as "hazardous substances" under CERCLA and developing groundwater cleanup levels "by the fall of this year" to guide the remediation of PFAS-contaminated sites;
- "Tak[ing] action in close collaboration with our federal and state partners to develop toxicity values for GenX and PFBS," two other types of PFAS, "by December of this year;" and
- Visiting Michigan, New Hampshire, and other states affected by PFAS contamination to aid in drafting a "national PFAS management plan" "that will be done by the fall of this year." [36]

In June 2018, ATSDR released its draft toxicological profile for PFASs, which ultimately did derive toxicity values that were much more stringent than the EPA health advisory limits.[37] Note, however, that ATSDR's values are specifically to be used as guidance at hazardous waste sites, not for drinking water MCLs.

**August 2018 – Congress Passes Military Spending Bill with PFAS Provisions.** The 2019 National Defense Authorization Act required DOD to study PFAS contamination at military bases and develop cleanup plans.[38] While this is the only recent federal legislation regarding PFAS to become law, Congressional interest has certainly increased in the past year alone, as reflected in Figure 2, below.

***Figure 2. Lobbying and legislative activity on PFAS spiked at the end of last Congress.***[39]




**February 2019 – EPA PFAS Management Plan.** EPA released its PFAS Management Plan on February 14, 2019. In the plan, EPA committed to:

- Propose a national drinking water regulatory determination for PFOA and PFOS;
- Initiate the regulatory development process for listing PFOA and PFOS as CERCLA hazardous substances;
- Develop interim cleanup recommendations to address groundwater contaminated with PFOA and PFOS;
- Finalize draft toxicity assessments for additional PFASs;
- Conduct new chemical reviews under TSCA for new PFASs and issue rules for new PFAS uses until EPA determines whether the new use presents an unreasonable risk;
- Provide technical assistance and resources to improve PFAS testing and monitoring methods and to enhance treatment and remediation technologies; and
- Employ an enforcement strategy to support state and local authorities in addressing ongoing PFAS release.[40]

Despite these commitments from EPA, it will likely be years before many of the substantive regulations are finalized. For example, the process of setting a drinking water MCL for specific chemical pollutants under the SDWA is a multiple step process that ordinarily takes years to complete. In addition, the SDWA stipulates that primary drinking water standards such as MCLs are to become effective 3 years after they are promulgated to allow water systems to adjust to the new requirements.[41] However, states often seek to shorten the implementation periods for new MCLs, which in this case would result in further discrepancies in regulation at the state level and less clarity about national regulatory standards for these chemicals.

**February 2019 – EPA Cites Manufacturer for PFAS Emissions Under TSCA. Last month,** EPA cited Chemours for failing to control PFAS emissions from plants in North Carolina and West Virginia.[42] Among other things, the notice of violation alleges that Chemours violated the terms of a 2009 consent order that allowed the firm to use GenX chemical substances in its manufacturing process only if it recovered and captured or recycled the chemicals at a 99% efficiency rate.[43]

**February 2019 – Government Launches Study of PFAS Health Impacts Near Military Bases.** Also last month, the Centers for Disease Control and Prevention (CDC) and the ATSDR announced that they will be conducting exposure assessments in communities near current or former military bases and that are known to have had PFAS in their drinking water.[44] The primary goal of these exposure assessments is to provide information to communities about levels of PFAS in their bodies, but the information gathered will also be used to help inform future studies evaluating the impact of PFAS exposure on human health.[45]

## III. State Action

Absent binding, enforceable regulations at the federal level, states have begun to enact their own regulation and legislation. As of this writing, at least 16 states have finalized at least 28 regulations with additional proposed rules forthcoming.[^] These regulations address PFAS management issues ranging from exposure limits for drinking water, groundwater cleanup standards, hazardous waste disposal, prohibiting PFASs in products, and children's products liability.

Only New Jersey has set a binding drinking water standard for a PFAS (0.013 μg/L for perfluorononanoic acid (PFNA)).[46] However, several states have proposed binding standards, at varying degrees of stringency. For example, New Hampshire recently proposed setting a drinking water MCL of 70 ppt for PFOA and PFOS combined,[47] while New York has proposed an MCL of 10 ppt.[48] These disparities highlight the differing risk tolerances in the face of scientific uncertainty.

Many states have also issued non-binding health advisory limits or binding notification limits for drinking water. For example, California has established a notification limit of 13 ppt for PFOS and 14 ppt for PFOA.[49] When drinking water exceeds these limits, the drinking water system must notify the water system's governing body and the governing body of any local agency that has jurisdiction over the areas supplied with the impacted drinking water.[50]

Several states have also finalized rules setting cleanup levels for PFASs in soil and/or groundwater, including Alaska,[51] Michigan,[52] and New Jersey.[53] Like drinking water standards, these cleanup standards vary and demonstrate differing risk tolerances. See Table 1, below.

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^ In some cases, states have issued more than one type of PFAS regulation. For example, New Jersey has issued a drinking water standard as well as a groundwater cleanup standard, as detailed below.

***Table 1. State PFAS drinking water and soil and/or groundwater cleanup standards***

| State | Regulated PFAS | Standard |
|---|---|---|
| *Drinking Water Standard* | | |
| New Jersey[54] | PFNA | 0.013 µg/L |
| *Soil Cleanup Standards* | | |
| Alaska[55] | PFOS | 0.00030 mg/kg - 2.2 mg/kg |
| | PFOA | 0.00017 mg/kg - 2.2 mg/kg |
| Iowa[56] | PFOS | 1.8 mg/kg |
| | PFOA | 1.2 mg/kg |
| Texas[57] | PFOA, PFOS, PFNA, PFBA, PFBS, PFHxS, PFHxA, PFPeA, PHFpA, PFOSA, PFDA, and PFSA | Various |
| Wisconsin[58] | PFOS and PFOA | 1.26 mg/kg – 16.4 mg/kg |
| *Groundwater Cleanup Standards* | | |
| Alaska[59] | PFOS and PFOA | 0.040 µg/L |
| Colorado[60] | PFOS and PFOA | 0.070 µg/L* |
| Iowa[61] | PFOS | 0.7 µ/L – 1.0 µg/L |
| | PFOA | 0.7 µg/L |
| Michigan[62] | PFOS and PFOA | 0.070 µg/L |
| New Hampshire[63] | PFOS and PFOA | 0.070 µg/L |
| New Jersey[64] | PFNA | 0.013 µg/L |
| North Carolina[65] | PFOA | 2 µg/L |
| Rhode Island[66] | PFOS and PFOA (total) | 0.070 µg/L |
| Vermont[67] | PFOS, PFOA, PFHxS, PFHpA, and PFNA (total) | 0.02 µg/L |

States have also begun to regulate PFAS in products. In November 2017, California listed PFOA and PFOS on the Proposition 65 list due to their developmental toxicity. As of November 2018, businesses in California have been required to provide a "clear and reasonable" warning before knowingly and intentionally exposing anyone to PFOA or PFOS.[68] Similarly, Washington's Children's Safe Products Reporting Rule requires manufacturers to report annually to the Washington State Department of Ecology (Ecology) the presence of PFOS and PFOA in children's products offered for sale in Washington.[69] In addition, the Washington state legislature has directed Ecology to publish the findings of an alternatives assessment that evaluates PFAS replacements for food packaging made from paper or other plant fibers by January 2020. After January 2022, PFAS may not be added to food packaging made from paper or other plant fibers if the alternatives assessment identifies multiple safer alternatives that meet certain requirements. Finally, both New York and Washington have placed restrictions on the sale and use of firefighting foam containing PFOA or PFOS.[70]

*This standard only applies to a portion of El Paso County, near Peterson Air Force Base.

## IV. Litigation

Because federal and state standards do not yet comprehensively provide relief for those impacted by PFAS contamination, many have turned to litigation. The status of PFAS regulation under federal and state laws differs and is in many cases unclear; therefore, relatively straightforward cost recovery claims under CERCLA or state law equivalents are not yet always available. This has prompted litigation under other common law or statutory schemes, including torts such as trespass, negligence, and nuisance. In addition, because PFAS contamination is particularly an issue near military installations, plaintiffs may begin to bring constitutional takings claims or claims under the Federal Tort Claims Act. There are currently over 60 cases filed within the U.S. related to PFAS, covering a wide range of claims.

### A. Toxic Tort Cases

One of the first lawsuits dealing with PFAS focused on the potential harm to human health caused by these chemicals. In Parkersburg, West Virginia, DuPont used PFOA to make Teflon for over 40 years. At this facility, DuPont released PFOA into the air from facility emissions, PFOA powder and waste water into the Ohio River, and sludge containing PFOA into digestion ponds near the facility. PFOA entered the local water table, contaminating drinking water for more than 100,000 people.[71] The plaintiffs in that case claimed injuries such as kidney cancer, testicular cancer, and thyroid disease resulting from drinking water contaminated by PFOA from DuPont's manufacturing facilities. In February 2017, DuPont reached a $671 million settlement with approximately 3,500 plaintiffs in Parkersburg.[72]

### B. Suits by Drinking Water Providers

Claims have also been brought by municipalities and drinking water providers against entities that caused contamination at a particular site. For example, several public water providers have sued manufacturing facilities contaminating their water supplies with PFASs;[73] a Massachusetts town has reached a settlement in a lawsuit against a local fire training academy for PFAS contamination of drinking water;[74] and Newburgh, New York and Martinsburg, West Virginia have both taken steps to sue the United States for alleged PFAS contamination stemming from military operations.[75]

### C. State Litigation

States have begun to bring suits to recover cleanup costs and natural resource damages caused by PFAS contamination.

For example, in February 2018, the State of Minnesota and 3M Company ("3M") entered into an agreement settling the State's claims against 3M for contaminating the State's natural resources by releasing PFAS into the environment.[76] For decades, 3M manufactured PFOS, PFOA, and other PFASs at facilities in the Twin Cities metropolitan area.[77] In the State's lawsuit, it alleged that 3M disposed of wastes containing PFASs at dedicated disposal sites, landfills, and unlined dumps, ultimately resulting in the contamination of four major drinking water aquifers supplying the sole source of drinking water for 125,000 residents.[78] The State brought claims against 3M under the Minnesota Environmental Response and Liability Act; the Minnesota Water Pollution Control Act; and various tort theories, including trespass, nuisance, and negligence. Under the settlement agreement,[79] 3M will pay $850 million to Minnesota through the 3M Grant for Water Quality and Sustainability Fund, which will fund a variety of water quality projects in the Twin Cities such as developing alternative water supplies; treating existing water supplies; and water conservation and efficiency projects.

In another example, the State of New York is suing six manufacturers of PFAS-containing firefighting foam to recover the cost of cleaning up environmental contamination caused by the use of that firefighting foam.[80] In its suit, filed on June 20, 2018 in New York state court, New York seeks more than $38.8 million plus punitive damages. New York claims, among other things, that the manufacturers knew, or should have known, that their products containing PFOA and/or PFOS, when used as intended, would likely injure and/or threaten public health and the environment.[81]

### D. Multi-District Litigation

The increased national interest in PFAS has resulted in proliferating suits across the country, with more likely to come. One main way that a defendant can regain control over an expanding liability landscape is by consolidating multiple cases into a Multi-District Litigation, or MDL.[82] While arguably the consolidation only consolidates the pre-trial proceedings (the cases are remanded to the original court for trial), an MDL's practical effect is to narrow discovery and provide a single consolidated venue to evaluate and (often) settle all current and future claims, such as in the asbestos products liability litigation and mega-settlement.[83]

As more and more tort cases are brought against manufacturers nationwide, they are ripe for MDL treatment. In December 2018, the Judicial Panel on Multi-District Litigation, at the request of defendants Tyco Fire Products, Chemguard, 3M, and others, consolidated 75 personal injury cases pending in courts across the country into a single MDL, *In re: Aqueous Film-Forming Foams Products Liability*.[84] This MDL includes all cases in which plaintiffs allege harm caused by the defendants from groundwater contamination due to the manufacture and use of PFAS-containing firefighting foams. This MDL is therefore likely to sweep in other emerging claims such as class action torts and products liability claims against firefighting foam manufacturers as additional contamination is found.

## V. State/Federal Conflict

An interesting recent development in the State of New Mexico signals possible conflict between states and the federal government, as states seek to protect their water supplies, while the United States and DOD seek to minimize their liability for PFAS contamination at and from military and other federal sites.

New Mexico has been seeking to compel the U.S. Air Force to address PFAS contamination at military bases in that state. The United States, potentially as a test case to limit state regulation, is fighting back. On January 17, 2019, the United States filed a complaint on behalf of the Air Force seeking to invalidate a permit that the State of New Mexico issued to Cannon Air Force base under the New Mexico Hazardous Waste Act.[85] The United States claims that, by including PFOS and PFOA in the definition of "hazardous waste," subject to corrective action in the Air Force Base's permit, the State of New Mexico acted outside the scope of its authority under the federal Resource Conservation and Recovery Act. The Air Force's complaint also states that enforcement of the permit conditions relating to PFAS is barred by sovereign immunity (because these compounds are outside of the scope of the federal waiver).[86]

This injunctive suit has not, however, discouraged the state's enforcement efforts; on February 6, 2019, the New Mexico Environment Department issued a Notice of Violation to Holloman Air Force Base for groundwater contamination with PFOA and PFOS, in violation of state water quality standards;[87] and on March 5, 2019, New Mexico filed a lawsuit of its own against the United States, alleging that the Air Force violated New Mexico's hazardous waste act by failing to address previous use of the chemicals.[88] The state seeks, among other things, injunctive relief to remediate the PFAS contamination.[89]

## VI. Conclusion

As scientists and regulatory agencies assess potential risks and regulatory strategies and states and drinking water providers increase testing for emerging contaminants, it is evident that PFASs and the environmental issues associated with these chemicals are here to stay. Federal and state regulators' slow progress toward designating PFASs as hazardous, promulgating binding cleanup and drinking water standards, and regulating the sources of these contaminants has created confusion for water suppliers, landowners, manufacturers, and the public. Until clear and binding regulations are in place, parties will likely turn toward complex and expensive litigation to address the sources of PFAS contamination, seek remedies to correct PFAS impacts, and recover costs from responsible parties.

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[1] See. e.g., Nadia Kounang, What are PFAS chemicals, and what are they doing to our health?, CNN, https://www.cnn.com/2019/02/14/health/what-are-pfas-chemicals/index.html (last accessed Mar. 11, 2019).

[2] U.S. EPA, Per- and Polyfluoroalkyl Substances (PFASs) Under TSCA, https://www.epa.gov/assessing-and-managing-chemicals-under-tsca/and-polyfluoroalkyl-substances-pfass-under-tsca (last visited Mar. 8, 2019); Wash. Dep't of Ecology, Perflorinated Compounds in Washington Rivers and Lakes (Aug. 2010) at 9, *available at* https://fortress.wa.gov/ecy/publications/documents/1003034.pdf.

[3] U.S. EPA, Per- and Polyfluoroalkyl Substances (PFASs) Under TSCA, https://www.epa.gov/assessing-and-managing-chemicals-under-tsca/and-polyfluoroalkyl-substances-pfass-under-tsca (last visited Mar. 8, 2019); XiaoZhi Lim, *Tainted water: the scientists tracing thousands of fluorinated chemicals in our*

*environment*, Nature, Feb. 6, 2019, *available at* https://www.nature.com/articles/d41586-019-00441-1?fbclid=IwAR0lfjmFqLWAB9luiaOB_-DkNnRIkND5pA9kV2isIccr32jDVPJmt3kB1gk&mc_cid=731b96f730&mc_eid=3c0d6cc117.

[4] XiaoZhi Lim, *Tainted water: the scientists tracing thousands of fluorinated chemicals in our environment*, Nature, Feb. 6, 2019, *available at* https://www.nature.com/articles/d41586-019-00441-1?fbclid=IwAR0lfjmFqLWAB9luiaOB_-DkNnRIkND5pA9kV2isIccr32jDVPJmt3kB1gk&mc_cid=731b96f730&mc_eid=3c0d6cc117. EPA breaks long-chain PFAS into two sub-categories: perfluoroalkyl carboxylic acids with eight or more carbons, including PFOA, and perfluoroalkane sulfonates with six or more carbons. U.S. EPA, Per- and Polyfluoroalkyl Substances (PFASs) Under TSCA, https://www.epa.gov/assessing-and-managing-chemicals-under-tsca/and-polyfluoroalkyl-substances-pfass-under-tsca (last visited Mar. 8, 2019).

[5] *Id.*

[6] *Id.*

[7] U.S. EPA, Per- and Polyfluoroalkyl Substances (PFASs) Under TSCA, https://www.epa.gov/assessing-and-managing-chemicals-under-tsca/and-polyfluoroalkyl-substances-pfass-under-tsca (last visited Mar. 8, 2019).

[8] Perfluorooctanoic Acid (PFOA), Fluorinated Telomers; Request for Comment, Solicitation of Interested Parties for Enforceable Consent Agreement Development, and Notice of Public Meeting, 68 Fed. Reg. 73, 18629 (Apr. 16, 2003) *available at* https://www.gpo.gov/fdsys/pkg/FR-2003-04-16/pdf/03-9418.pdf.

[9] Zhanyun Wang, et. al, *A Never-Ending Story of Per- and Polyfluoroalkyl Substances (PFASs)?*, Environmental Science & Technology (Feb. 22, 2017).

[10] Wash. Dep't of Ecology, Perflorinated Compounds in Washington Rivers and Lakes (Aug. 2010) at 33, *available at* https://fortress.wa.gov/ecy/publications/documents/1003034.pdf.

[11] U.S. EPA, Fact Sheet PFOA & PFOS Drinking Water Health Advisories (Nov. 2016) at 2, *available at* https://www.epa.gov/sites/production/files/2016-06/documents/drinkingwaterhealthadvisories_pfoa_pfos_updated_5.31.16.pdf. *See also* U.S. EPA, Health Effects Support for Perfluorooctane Sulfonate (PFOS) (May 2016), *available at* https://www.epa.gov/sites/production/files/2016-05/documents/pfos_hesd_final_508.pdf; U.S. EPA, Health Effects Support for Perfluorooctanoic Acid (PFOA) (May 2016), *available at* https://www.epa.gov/sites/production/files/2016-05/documents/pfoa_hesd_final_508.pdf.

[12] XiaoZhi Lim, *Tainted water: the scientists tracing thousands of fluorinated chemicals in our environment*, Nature, Feb. 6, 2019, *available at* https://www.nature.com/articles/d41586-019-00441-1?fbclid=IwAR0lfjmFqLWAB9luiaOB_-DkNnRIkND5pA9kV2isIccr32jDVPJmt3kB1gk&mc_cid=731b96f730&mc_eid=3c0d6cc117.

[13] *Id.*

[14] *See* Nathaniel Rich, *Rob Bilott v. DuPont*, N.Y. Times Magazine, Jan. 10, 2016 at MM36.

[15] *See Donavan v. Saint-Gobain Performance Plastics,* Complaint and Demand for Jury Trial (July 27, 2016).

[16] *See* Kyle Bagenstose, *Records: Military knew of foam dangers in 2001*, Bucks County Courier Times, Jul. 15, 2017, http://www.buckscountycouriertimes.com/8fb1f91c-9848-5d77-89e5-22c80d1fee86.html (last visited Mar. 8, 2019).

[17] U.S. Government Accountability Office, *Drinking Water Status of DOD Efforts to Address Drinking Water Contaminants Used in Firefighting Foam* (Sept. 26, 2018), *available at* https://www.gao.gov/assets/700/694759.pdf.

[18] *Id.*

[19] Interstate Technology Regulatory Council, *Site Characterization Considerations, Sampling Precautions, and Laboratory Analytical Methods for Per- and Polyfluoroalkyl Substances (PFAS)* (Mar. 2018), *available at* https://pfas-1.itrcweb.org/wp-content/uploads/2018/03/pfas_fact_sheet_site_characterization_3_15_18.pdf.

[20] *Id.*

[21] *Id.*

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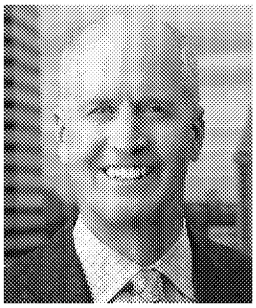


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Jeff Kray is an environmental litigator. His practice focuses on water quality, water resources, and complex environmental litigation, including Clean Water Act permitting and regulatory compliance, and CERCLA (Superfund) site remediation. He has represented public and private clients throughout the country. Over a 26 year career, Jeff has conducted numerous trials, litigated administrative hearings, and appeared in federal and state appeals.

Jeff regularly advises businesses and local government in water quality permit compliance and defense matters, responding to emerging contaminants (including PFAS) in water supplies, stormwater pollution prevention, hazardous waste spill prevention and cleanup, and cost recovery litigation. He also frequently consults with water right owners and purchasers on preserving, acquiring, and transferring water rights. He has assisted a broad range of clients, including water suppliers, irrigation districts, municipalities, developers, manufacturers, commercial and timber land owners, interstate transporters, lumber mills, and ports.

Jeff is a frequent speaker and writer on water law and policy, particularly on the intersection between water rights and water quality. He has lectured extensively on the Clean Water Act, state water quality laws, and state and federal water rights. He has held leadership positions in the Water Resources and Water Quality and Wetlands Committees of the American Bar Association's Section on Environment, Energy, and Resources.

### SELECT REPRESENTATIVE EXPERIENCE

Lead counsel in advising multiple municipal water suppliers on responding to PFAS contamination to groundwater and providing representation on cost recovery for response costs, water quality treatment, and Safe Drinking Water Act compliance. Provide testimony on clients’ behalf to Washington State Legislative Committee and participate in consultations with the Washington Department of Ecology on proposed PFAS regulations.

Lead counsel in multiple cases successfully prosecuting and defending claims to recover environmental cleanup costs under the federal Comprehensive Environmental, Response, Compensation, and Liability Act (CERCLA) and Washington's Model Toxics Control Act (MTCA) or similar state laws in Washington, Oregon, Alaska, and California. Representative cases have involved industrial dry cleaners, former landfills, gas stations, salvage and recycling facilities, manufacturing facilities, and lumber mills.

Lead defense counsel before the U.S. District Court and the U.S. Court of Appeals for the Eighth Circuit on behalf of the owner of an agricultural chemical company in consolidated actions by EPA and private parties and involving cleanup cost recovery claims and contribution. This complex case involved five separate lawsuits, including several environmental and cost recovery claims, insurance coverage litigation, and probate.

Lead defense counsel in over thirty Clean Water Act citizen actions, including five inter-related federal lawsuits involving regulatory compliance with industrial stormwater permits. All five suits were successfully settled via a consent decree approved by the Department of Justice and U.S. District Court.

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Sarah Wightman's practice focuses on environmental, natural resources, and land use litigation and compliance, as well as product and environmental counseling. She helps public and private clients navigate complex legal issues such as drinking water contamination, hazardous waste regulations, product safety and stewardship, environmental cleanup, stormwater management, water rights, land use and zoning, and renewable energy development.

Sarah earned her Juris Doctor from the University of Michigan Law School, where she was the Editor-in-Chief of the *Michigan Journal of Environmental and Administrative Law.* While at the University of Michigan Sarah also earned a Master of Science in Natural Resources and Environment, specializing in environmental policy and planning. In addition, Sarah worked as a law clerk for the U.S. EPA and completed legal research and writing projects for the National Wildlife Federation, the Graham Sustainability Institute, and the cities of Flint and Detroit.

Prior to law school, Sarah wrote and managed a watershed-based plan as part of a multi-year, multimillion-dollar federal grant, ensuring the project's regulatory compliance with federal and state agencies. Sarah earned her Bachelor of Science, *summa cum laude,* from the University of Kentucky in natural resource conservation and management.